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THE STATUS OF THE HERRING IN THE BRAS D'OR LAKES IN 1996-1997

BY

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ABSTRACT

The Bras d'Or Lakes herring spawning component has not been examined in detail since 1981. A study initiated in 1996 by the Eskasoni Fish and Wildlife Commission and Science Branch of the Department of Fisheries and Oceans has led to the collection of more information on the commercial and bait fisheries. Egg bed, spawning and larval surveys, combined with a questionnaire survey of fishers, have further elucidated the status of herring in the Lakes.

Analysis of data collected in this study indicates a deterioration in the status of the Bras d'Or Lakes herring stock. This is corroborated by the dramatic decrease in the number of spawning locations, the low number of larvae collected during a larval survey and the absence of fish at several traditional fishing locations. The intensive concentration of effort on the few remaining spawning sites has also been observed - in the Barra Strait in 1996 and in Baddeck Bay in 1997. Finally, the narrow age distributions of the samples collected during the 1996 and 1997 commercial fishery are possible indicators of weak recruiting year classes.

RÉSUMÉ

La composante de hareng géniteur du lac Bras d'Or n'a pas été étudiée en détail depuis 1981. Une étude entreprise en 1996 par l'Eskasoni Fish and Wildlife Commission et le secteur des Sciences du ministère des Pêches et des Océans a permis la collecte de données supplémentaires sur la pêche commerciale et la pêche de hareng pour appât. Les relevés portant sur les oeufs, les géniteurs et les larves, combinés à un questionnaire auprès des pêcheurs, ont permis de mieux connaître l'état du hareng du lac.

L'analyse des données recueillies dans le cadre de la présent étude montre une détérioration de l'état du stock de hareng du lac Bras d'Or. Ces résultats sont corroborés par la baisse spectaculaire du nombre de frayères, le faible nombre de larves recueillies pendant le relevé et l'absence de poisson dans plusieurs zones de pêche traditionnelles. On a également observé une forte concentration de l'effort sur les quelques sites de frai qui restent, dans le détroit de Barra en 1996 et dans la baie Baddeck en 1997. Enfin, l'étroitesse de la distribution des âges dans les échantillons recueillis pendant la saison de pêche commerciale de 1996 et 1997 est un indicateur possible de faibles classes d'âge de recrutement.

1) *Introduction*

1.1 Background and Context

The Bras d'Or Lakes herring fishery traditionally occurs in the spring just after the ice disappears from the Lakes and the catch is used primarily for lobster bait. The recent history of this fishery is largely undocumented but there has been an increase in effort as a result of the escalating cost of bait and the realization by fishers that an HFA17 herring gill net license can be fished in the Lakes (A. MacIsaac, DFO Area Office, Sydney, pers. comm.). The starting date of the fishery is usually dependent on the amount of ice in the Lakes, and the ending date is related both to the start of lobster season (May 9, unless otherwise delayed), and the dispersal of herring through the Lakes after spawning. In the past, the fishery has tended to last about 30 days from early April until the first or second week of May.

Anecdotal information has indicated a reduction in fish abundance, and there has been concern expressed both over the increase in total effort, and the way in which that effort has been focused in the entrance to the "Big Lake" at the Barra Strait and around individual spawning beds. Gear has been moved to new locations from areas where catches were good in the past. Notes taken by J. Fennell, the DFO port sampler based in Cape Breton, show a decline in the number of active spawning grounds and the number of good fishing locations since 1991 (**Appendix 1**). In recent years there was an increase in effort on the north side of the bridge in the Barra Strait and on the eastern side of the "Big Lake" from Derby Point to Benacadie Point. This changed in 1997 when effort was concentrated in Baddeck Bay due to poor catches in other areas.

1.2 Historical Catch Record

The landings statistics are known to be incomplete since there is a large bait fishery as well as a commercial fishery in the Bras d'Or Lakes. Landings from this bait fishery are largely unrecorded. Getting an accurate picture of the amount of fish taken from the Lakes is further complicated by the fact that six statistical districts (3,4,6,7,8 and 9) converge in the middle of the Lakes and all of these districts include areas outside the Lakes (**Figure 1**). Because of this, the commercial landings for the Lakes were determined by examining records by port of landing from the six relevant statistical districts for March, April and May. Records from communities outside the Lakes were eliminated for the purposes of this calculation. The results are shown in **Figure 2**. Landings from the early 1970s are extremely low perhaps due to a lack of reporting but from 1978 onwards they are in the range of 86t (1985) to 400t (1987) averaging 181t overall from 1978 to 1997.

1.3 Previous Studies of the Bras d'Or Lakes Herring

Between 1982 and 1996, little information has been gathered from the Bras d'Or herring fishery, other than commercial landings statistics. A study conducted in 1978 by the Nova Scotia Department of Fisheries collected data on gear, fishing activity, stock abundance, spawning sites and physical and biological factors associated with the Nova Scotia inshore herring fishery and included the Bras d'Or Lakes (Crawford 1979). A later study, also by the Nova Scotia Department of Fisheries, focused specifically on Bras d'Or Lakes herring and involved a detailed examination of egg bed substrate, hatching and larval distribution and growth at Ross Cove, West Bay as well as an examination of samples from the commercial fishery. Spawning was reported to occur in Clarke Cove, MacKenzie Cove, Little Harbour, Ross Cove and North Cove (all in West Bay) and in St. Peter's Inlet (Crawford 1979, Crawford et al. 1982) and larval herring were reported in concentrations up to 4,655 larvae/m^3 in Ross Cove (Crawford et al. 1982).

Since 1981 and prior to 1996, there have been no studies conducted specifically on Bras d'Or Lakes herring although some herring larvae were collected during an egg and larval icthyoplankton survey conducted in 1991. Larvae were found at 12 locations in concentrations varying from 1.64 to 15.08 larvae per 1000m^3 (T. Lambert, pers. comm). A further ichthyoplankton survey was conducted in 1996 in East Bay, West Bay and the main Bras d'Or Lake but to date only 6 samples have been sorted. In the sorted samples, only one larva was found (at the head of East Bay, 45° 58.5' N 60° 28' W) (T. Lambert, pers. comm).

2) *Bras d'Or Lakes Herring Study*

2.1 Introduction

In April of 1996, the Eskasoni Fish & Wildlife Commission in collaboration with the Department of Fisheries and Oceans, began a four-year study of the biology of herring and the herring fisheries of the Bras d'Or Lakes. The study was prompted by recent concern that there are fewer herring returning to the Bras d'Or Lakes to spawn and involves sampling of the commercial fishery, tagging and surveys of herring larvae and egg beds with the timetable shown in **Table 1**.

2.2 Accomplishments during 1996

The study began on April 4, near the beginning of the 1996 fishery. It commenced with field sampling of the spring fishery, then progressed to testing existing trap nets and surveying spawning grounds. It culminated with a post-season survey of active fishers and the analysis of biological samples.

2.2.1 Workshop

A workshop was held in Eskasoni from April 24-25, 1996. It was attended by DFO staff from St. Andrew's and Sydney, staff from EFWC, representatives from the Nova Scotia Department of Fisheries and Bras d'Or fishers. The objective of the workshop was to discuss and develop a strategy for implementation of the four year project. Herring caught in the EFWC trap net on April 25, 1996 were used for training purposes. Plans were made to send a team from Eskasoni to St. Andrew's to process the herring samples.

2.2.2 Biological Sampling of the Fishery

Sampling effort was high in the 1996 fishery (**Table 2**), a marked change from earlier years. Sampling was distributed throughout the fishery, with the possible exception of the northernmost bays. Between April 8 and May 6, 1996, 33 herring samples were collected from the Bras d'Or Lakes (5496 fish measured; 296 fish aged). These included samples taken by EFWC staff from commercial fishers in the Iona, Benacadie, Johnstown and Big Harbour Island ports, samples from gill nets the EFWC set in Crane Cove (in Eskasoni) and four additional samples collected by J. Fennell (DFO, Sydney) (**Figure 3**).

Routine examination of samples taken from the Bras d'Or involved recording total length, whole weight, gonad weight, sex, stage of maturity, and removing otoliths for ageing. This examination was performed in June by four technicians from the EFWC under the supervision of DFO technical staff in St. Andrews. Otoliths were aged by M. Power (DFO, St. Andrews).

2.2.3 Trap Net

A trap net was used on a trial basis to determine its effectiveness in catching herring in preparation for sampling and tagging the following year. It was set on April 22 in Ansulm Cove in Eskasoni. The trap net was checked daily from April 23 to May 1 but did not trap herring until April 25 when 4 were caught. Only cod were trapped thereafter. The herring may have left the area by then, as most fishing ceased after April 23 in all parts of the lake, or there may not have been herring in that area. In addition, this net was designed for trapping salmon and may not have been suitable for trapping herring. It was taken out of the water on May 2.

2.2.4 Survey of Egg Beds

The EFWC office was notified by Wagmatcook guardians of 2 areas where spawning had been witnessed by Native fishers. On May 3, Wagmatcook (near the "fisheries road" on the reserve) and the wharf at Herring Choker in Nyanza were examined for spawn by wading through the water and looking for eggs from above. No eggs were observed, however this may be attributed to inexperience. Starting May 8, one of the guardians was assigned to snorkel various coves where spawning had occurred in previous years. The following areas were checked: Kuliks Pt., West Bay Cove, Marble Mountain (MacMillians), MacDonalds Cove, Morrison Cove, Crooked Cove, Cassells Cove, Portage Creek, Estmere, Kennedy's Pt - Fraser's Cove, Campbell's Island (west side), MacRae's Cove, Cribwork Cove, Neily Pt Inlet, Christmas Pond, MacPhee Isle (west), Crane Cove, Indian Isles, MacAdams Pt Inlet, East Bay Beach Pond, Loch More Harbour.

Eggs were found washed on shore of MacRaes Cove about 100 ft to the left of the bridge on May 18 by the director of the EFWC. High winds were prevalent on May 16. No eggs were observed in the eel grass. Photos of this area are available.

Eggs were observed between the sites of Birch Point and the small island off Big Harbour Island (45° 52.4' N, 60° 56.0' W) on May 21. The spawning bed measured 1200 ft along the shoreline and 58 to 60 ft out from the shore (approximately 6475 m^2). Substrate was found to be solid and covered with sand. Eel grass was dense in some areas and scattered in others. The height of the eel grass ranged from 2 to 20 cm. General observations, temperature and salinity of this spawning bed were recorded when possible as listed in **Table 3**.

Several traditional spawning areas were confirmed to be active by fishers and by the egg bed survey. An "egg grabber", an elongated metal claw, was initially used to determine egg presence in a particular area. Once eggs had been found (usually attached to eel grass or seaweed that the egg grabber raked out), a diver was sent in. The diver attempted to measure the parameters of the egg bed but since egg deposits were patchy, the thickness, length and width of egg beds could not be determined.

The fishery and subsequent questionnaire indicated spawning at Birch Point, Fiddle Head, Fraser's Cove, an area between Morrison's Cove and Gillis Cove, Orangedale, and Herring Choker Cove. Traditional spawning areas, areas surveyed in 1996, and areas of recorded spawning in 1996 are shown in **Figure 4**.

2.2.5 Fisher Questionnaire

A questionnaire was conducted to document aspects of the 1996 fishery (1996 catch amounts, location and effort), historical information (changes in catch and effort over time), and biological observations and opinions (e.g. the location of spawning grounds and migration routes). Documentation has been poor in this fishery, and it was hoped

that this questionnaire would provide some important historical information. Twenty nine of the 30 fishers known to have been active in the 1996 fishery were interviewed in person. The questionnaire and summaries of the responses are presented in **Appendices 2** and **3**.

The interview questionnaire results indicated:

- a decrease in the abundance of herring in the Bras d'Or Lakes
- an increase in effort in the Bras d'Or Lakes in recent years
- the restriction of spawning in 1996 to only a few of the traditional spawning grounds and the lack of spawning in the south-western portion of the Lakes

2.2.6 Evaluation of the 1996 fishery

Landings were estimated from the interview survey to have been between 376,000 and 392,000 lbs (approximately 170t). Landings recorded from purchase slips, supplementary B slips and logs (DFO Sydney) were estimated to be approximately 136t. In addition to the gillnet fishery, there may have been Bras d'Or Lakes spring spawners taken outside of the lakes in the 4Vn winter purse seine fishery.

The majority of fish taken in the spring fishery were between 30 and 35 cm (mode 32-33cm) (**Figure 5**), and the size was not appreciably different over time (**Figure 6**) or area of the Lakes (**Figure 7**). Age analysis indicates that the fishery was dominated by age 7 (1989 year-class) and age 8 (1988 year-class) fish (**Figure 8**). These year-classes made up 58% by number and 59% by weight of the total landings (**Table 4**). The 1990 and 1991 year-classes may be relatively weak, as they would be expected to be more prominent in gillnets of the size used in this fishery.

The enhanced sampling and survey of 1996 confirmed the general impression within the industry that there has been a decrease in the abundance of herring in the Bras d'Or lakes and an increase in effort in recent years. It was also determined that spawning in 1996 was restricted to only a few of the traditional spawning grounds and there was no spawning in traditional areas in the south-western portion of the Lakes. The narrow age distribution from the 1996 samples showed that there is a possibility that recruiting year-classes are relatively weak. As a result of these negative signals, it was recommended in the 1997 Stock Status Report that, "effort in the Bras d'Or Lakes commercial and bait fisheries should be reduced, so as to reduce landings of this spawning group" (Anon, 1997).

2.3 Accomplishments during 1997

2.3.1 Introduction

The 1997 fishery began much later than 1996. A few fishers began setting nets about April 4, but herring did not appear on the usual April fishing grounds. Significant

catches did not occur until April 28, 24 days later than in 1996, and occurred first in Baddeck Bay which had previously only a small fishery. The fishery continued until May 8, 1997. The 1997 study began with field sampling of the fishery, then progressed to setting a gill net and trap net near Eskasoni, surveying spawning grounds and conducting two larval herring surveys using the R.V. Navicula.

2.3.2 Biological Sampling of the Fishery

As in 1996, sampling started once the spring fishery began and continued until the fishers took their nets out of the water. The lobster fishery in the Bras d'Or Lakes (Area 28) commenced on May 9 and thus, the majority of fishers pulled their nets by this date. The 1997 fishery lasted only 11 days, in contrast to about 30 days in previous years. Between April 28 and May 8, 1997, a total of 22 herring samples were collected from the Bras d'Or Lakes (3749 fish measured, 317 fish aged) (**Table 5**, **Figure 9**). These included 16 samples taken by the EFWC and 6 samples collected by J. Fennell (DFO, Sydney). Sampling of the EFWC nets in the Eskasoni area continued until May 13, 1997. There were some differences between the areas sampled in 1997 and those sampled in 1996 because of the shorter fishery and the difference in the distribution of effort. Sampling time was divided between areas where the fishery was concentrated.

Detailed samples were processed in October, 1997 by three technicians from the EFWC under the supervision of DFO technical staff in St. Andrews. Otoliths were aged by M. Power (DFO, St. Andrews).

2.3.3 Gill and Trap Nets

A gill net was set by the EFWC in the area of "Black Rock" (45° 55.24' W, 60° 30.45' N), near Eskasoni on May 8 and removed on May 15/97. This area was once known as a spawning area for herring but large aggregations of herring have not been observed in the eastern portion of the Lakes in several years. Three samples were obtained.

A trap net was set to determine its effectiveness in catching herring. The net was borrowed from a local fisher and had trapped herring in the past. The trap net was set at Black Rock, east of Crane Cove on May 8, 1997. After several days of failing to trap anything, it was relocated to "Charlie Morris's" (45° 55.25' W, 60° 30.46' N) on May 13, 1997. It failed to trap a second time and was removed within the week. It is likely that there were simply no fish to trap so late in the season and in that area of the Lake. In 1998 the Eskasoni location will be discarded in favour of an area such as Baddeck Bay or Big Harbour Island, where there is more active spawning and therefore a greater probability of trapping herring.

2.3.4 Survey of Egg Beds

Sampling in 1997 consisted of more dive and egg grab surveys, and observations from the fishery. In the upper portion of West Bay (Big Harbour Island area), fishers reported that spawning took place at 6 sites in 1996. In 1997 spawning occurred at only 1 out of the 4 sites surveyed and a spawning site was found in an area where spawning had not been reported before (45° 55.03' W, 60° 55 20' N). Eggs were observed washed ashore on Fiddle Head. In Baddeck Bay, spawning reported in 1996 also occurred in 1997.

There were no reports of spawning in the lower portion of the Lake (St. Peter's to Johnstown) and West Bay, areas which are traditional spawning grounds (Crawford et al., 1982). It was reported that the herring did not migrate further than Lime Hill and that fishers were not catching a significant amount at any time in the St. Peter's area so the likelihood of any spawning was minimal. In East Bay, no spawning was observed in any of the traditional spawning areas again this year. Other areas which were suspected to be spawning areas for herring, such as Piper's Cove, were also surveyed but there was no evidence of spawning.

2.3.5 Larval Survey

In 1997, two icthyoplankton surveys were conducted using the R.V. Navicula to determine the concentration and distribution of larval herring within the Bras d'Or Lakes. The first survey was conducted in mid May and was thought to be too early in the season. No larval herring were caught. The second survey, Navicula 97-078, was conducted from June 20 to 26. Samples were sorted and enumerated by the Atlantic Reference Centre (ARC). Herring larvae were caught in very small numbers in only 16 out of 53 sets **(Table 6, Figure 10)**.

2.3.6 Evaluation of the 1997 Fishery

In 1997 landings of 168t were estimated for the spring fishery in the Lakes; two thirds of this total were accounted for by log records, whilst the remaining one third was an estimate of the amount caught for personal use. Twenty four commercial licenses were issued for herring in 1997 for this area, however, at the peak of the spring fishery, it is estimated that there were at least 35 fishers operating in the Lakes.

In 1996 concern was expressed over the continued increase in effort on the north side of the bridge across the Barra Strait. Initially so many fishers set their nets in the Barra Strait that DFO was required to do a rotary fly-over in response to a complaint that the nets were set too close together. Despite this concentration of effort, catches in this area were low. There were also few fish caught in the spring in the traditional areas of Johnstown, St. Peters and Marble Mountain. As a result, there was a shift of effort from

the Barra Strait to Baddeck Bay. In contrast to the low numbers of fish at traditional locations, good catches were reported from the north side of the Big Lake and as many as 20 fishers set their nets in Baddeck Bay compared to four or five fishers in 1996.

On May 1, 1997 (several days after the start of the fishery) the completion of log records became a condition of the commercial license. Fishers were required to record the quantity of herring sold but not the amount taken for bait. Due to organizational difficulties and the lack of dockside monitoring, only 14 out of 24 commercial fishers submitted logs. Of these 14 fishers, only one recorded latitudes and longitudes, 5 recorded general locations and 1 recorded a very vague location, so that there are only location records for one quarter of the licenses fished. The log records accounted for 207,379 lbs which included some herring kept for personal bait. Total landings ranged from 550 lbs to 85,841 lbs per license fished for an average of 14,813 lbs per license. Nine of the 14 fishers recorded the number of nets fished which ranged from 3 to 20.

The majority of fishers made no comments on the logs, recording only the bare minimum of information. Despite this, the movements of the herring in the Big Lake can be determined from the detailed notes made by a small number of fishers. According to these notes, on April 26th. fish were found only in Pipers Cove. On April 27th. they were moving from Pipers Cove towards MacKinnons Harbour across the Strait. On April 29th. the herring were heading towards Orangedale and by April 30th. they were up in River Deny's Basin. Spawning was noted at Fraser's Cove on May 1st. but by May 4th. the fish were heading west. Although the majority of fishers did not provide this amount of detail on their logs, those that did provided important insights into the movement and behaviour of the fish. It is important that fishers be encouraged to complete the log records and that DFO Science staff get timely access to the records so that the information can be used in the assessment process.

There was a reduction in the number of locations and area of the fishery, apparently linked to a further reduction in the number of active spawning areas. At the same time there appears to have been an increase in fishing effort, and a concentration of that effort primarily in the Baddeck Bay area. Logs for the Baddeck Bay area were submitted by only one fisher who recorded catching 6,160 lbs of fish with eight nets in nine days - an average of 684 lbs per day.

The majority of fish taken in the 1997 spring fishery were between 31 and 35 cm (mode 32-34 cm) (**Figure 11**). There was some variation in size over time with a bimodal length frequency distribution being noted in samples collected during the first week of the fishery (**Figure 12**). This bimodality was evident in two out of the three samples taken during the first week - one from North Pond and one from Benacadie and it is also evident when the length frequencies are examined by location of sampling (**Figure 13**). Age analysis indicated that the fishery was dominated by age 7 (1990 year-class) and 8 (1989 year-class) (**Table 7**, **Figure 14**) whilst ages 4 to 6 and age 9 fish were less prevalent than expected. The age 7 and 8 fish made up 54% by number and weight of the total catch.

In September 1997, a fall run of herring was observed near St. Peter's. This is consistent with reports from the previous year and with sounder observations of large schools of herring in that area at the same time. Many fishers did not set nets because the price for herring had dropped to 3 cents per pound. There are no landings records from the fall fishery, but a sample collected from St. Peters by J. Fennell (DFO Port Sampler) contained roe fish (**Figure 15**). The fish were comparable in size to those caught in the spring fishery, ranging from 30 to 35cm with a modal length of 32 to 32.5cm (**Figure 16**).

3) *Discussion*

The Bras d'Or Lakes herring fishery has long been relied upon for food and lobster bait. The increased effort currently being applied seems to be putting this fishery at risk. The current study reveals a decrease in the number of active spawning grounds in 1996 and a further decrease in 1997. In addition, the low number of larvae recorded in the June 1997 survey is further cause for concern and contrasts with the higher numbers recorded by Crawford et al. (1982) in 1981 and Lambert (pers. comm.) in 1991.

In the past, effort has been focused on the Barra Strait and in the "Big Lake" including the St. Peter's, West Bay, Johnstown and Malagawatch areas. This effort has increased, particularly in the Barra Strait, in recent years. The high number of nets in the Barra Strait led to a concern that fish were being prevented from entering the "Big Lake" and this was cited as the reason for the low catches at many of the traditional fishing locations. In 1997, however, the effort switched to Baddeck Bay due to a lack of fish in the Barra Strait. The large increase in effort in Baddeck Bay means that landings for 1997 stayed within the normal range but the source of these landings was different from 1996.

Commercial samples from 1996 and 1997 show a similar age distribution with the fishery being dominated by age 7 and 8 fish. That there was no progression to age 8 and 9 fish in 1997 was somewhat surprising but in general, the narrow age distributions of the samples from both years are possible indications of weak recruiting year-classes. Age distributions from Crawford et al. (1982) show a dominance of ages 5, 6 and 7 herring in 1980 and ages 4, 5 and 6 in 1981. The lack of large numbers of age 4 and 5 fish in catches from 1996 and 1997 is, therefore, cause for concern.

Overall, the results of the increased sampling, larval survey and 1996 fisher questionnaire survey confirmed the impression that there has been a decrease in herring abundance and an increase in concentrated effort in recent years.

4) *Management Plan for 1998*

In an attempt to conserve the Bras d'Or herring stock, the 4Vn Herring Working Group Committee proposed a one-year Management Plan for the Bras d'Or Lakes for 1998. The plan was developed in an attempt to reduce and change the distribution of effort in the Lakes. Bait fishers were to be reduced to a limit of 3 nets and an individual quota of 5,000 lbs. Log books were to be submitted weekly to a monitoring company and the fishery was to be reduced to five days a week with closure on Saturday and Sunday. Commercial fishers were required to reduce their gear by 50% but were still permitted to fish seven days a week. Logs were to be filled in daily before off loading and mailed weekly to a monitoring company. Both bait and commercial fishers were limited to a minimum mesh size of 2½ inches and they were required to identify themselves as fishing the Bras d'Or Lakes when picking up their Conditions of License. Six spawning areas were designated as closed to all fishing (**Figure 17**).

5) *Recommendations*

It was noted in the 1997 Stock Status Report that the status of herring in the Bras d'Or Lakes was cause for concern (Anon, 1997). In 1997, with the further decrease in spawning locations, low levels of larvae and the increase in fishing effort, the situation appeared to be worse. The 1998 Stock Status Report stated that, "given continued deterioration in signals from the Bras d'Or Lakes fishery it is preferable, from a biological perspective, that **no fishing take place on this spawning component**" (Anon, 1998).

If fishing is allowed to continue, it is recommended that:

1. Overall effort be reduced and the concentration of effort at one or two locations in the Lakes be prevented.

2. The collection of landings statistics be improved and the completion of logs as a license requirement be enforced.

3. The complete occlusion of spawning grounds and major fishways be prevented.

4. The closed spawn areas suggested in the 1998 management plan be enlarged to include a greater proportion of key spawning areas, particularly in the area of Malagawatch to McKinnons Point.

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Table 1. Timetable for the Bras d'Or Lakes herring study (X - planned, C - completed, O - optional).

	Activity	1996	1997	1998	1999
1A	Literature summary	C			
B	Survey of fishers	C			
2A	Trap net plus tagging	X	X	X	X
B	Sample landings	C	C	X	O
C	Survey larvae		C		
D	Spawning bed survey		C	X	
3A	Summarize results		C	X	X
B	Define potential for index fishers				X
C	Outline further requirements				X

Table 2. Summary of sampling information for the 1996 spring herring fishery in the Bras d'Or Lakes.

Location	# Samples	# Fishers Sampled	# Fish Measured	# Detailed Samples	# Fish Aged
Benacadie	11	2	1989	1	22
Crane Cove	5	1	296	2	48
Iona	9	3	1827	4	109
Johnstown	4	1	652	3	69
North Pond	1	1	149	1	23
Pipers Cove	1	1	208	1	25
St. Peters	2	1	375	0	0
Total	**33**	**10**	**5496**	**12**	**296**

Table 3. General observations, temperature and salinity of spawning bed near Birch Point in 1996.

Date	Temp. (°C)	Salinity (ppt)	Comments
May 24	7.8	21.4	
May 27	8.5	21.5	Less eggs than before
May 29			Eggs no longer attached to eel grass; settled to bottom. Eye spots visible
May 30			High winds
May 31			Eggs washed on shore, covering shore - even more washed up than in MacRaes Cove. Difficult to see bottom. Eggs that were found seemed to be pale in colour with no eyespots visible.

Table 4. 1996 age composition of catch in numbers and weight

	1	2	3	4	5	6	7	8	9	10	11+	Total
Total No. ('000s)	0	0	0	1	45	110	186	162	38	34	23	599
Total No. (%)	0	0	0	0.2	7.5	18.4	31.1	27.0	6.3	5.7	3.8	100
Total Catch (t)	0	0	0	0.2	10.0	27.1	49.0	44.8	11.1	10.2	7.4	160
Total Catch (%)	0	0	0	0.1	6.3	16.9	30.6	28.0	6.9	6.3	4.6	100
Avg. Len. (cm)	0	0	0	29.0	30.3	31.4	32.2	32.9	33.6	33.8	34.8	
Avg. Wt. (g)	0	0	0	200	223	246	263	276	293	298	319	

Table 5. Summary of sampling information for the spring herring fishery in the Bras d'Or Lakes for 1997.

Location	# Samples	# Fishers Sampled	# Fish Measured	# Detailed Samples	# Fish Aged
Baddeck	7	4	1351	2	62
Benacadie	2	1	314	2	51
Black Rock	3	1	412	2	44
Fiddle Head	2	1	418	1	22
Iona	1	1	177	1	27
Malagawatch	3	3	596	1	31
North Pond	3	2	355	3	49
Pipers Cove	1	1	126	1	22
Total	**22**	**14**	**3749**	**13**	**308**

Table 6. The number of larval herring and clupea-like larvae per station and set from the June survey of the Bras d'Or Lakes, Navicula 97-078.

Station	Set Number	Number of Larvae
9	1	1
11	3	2
12	25	4
19	31	1
22	28	2
23	27	3
27	26	1
29	44	1
35	51	1
36	50	1
38	47	1
43	4	1
48	19	2
49	24	1
50	20	1
51	23	8
52	21	1

Table 7. 1997 age composition of catch in numbers and weight.

	1	2	3	4	5	6	7	8	9	10	11+	Total
Total No. ('000s)	0	0	0	11	42	105	167	162	62	34	30	613
Total No. (%)	0	0	0	1.8	6.9	17.1	27.2	26.4	10.1	5.5	4.9	100
Total Catch (t)	0	0	0	2.2	9.4	26.2	45.0	46.4	18.6	10.6	9.8	168
Total Catch (%)	0	0	0	1.3	5.6	15.6	26.8	27.6	11.1	6.3	5.8	100
Avg. Len. (cm)	0	0	0	28.7	30.1	31.3	32.4	33.1	33.7	34.3	35.0	
Avg. Wt. (g)	0	0	0	199	225	248	270	286	299	311	329	

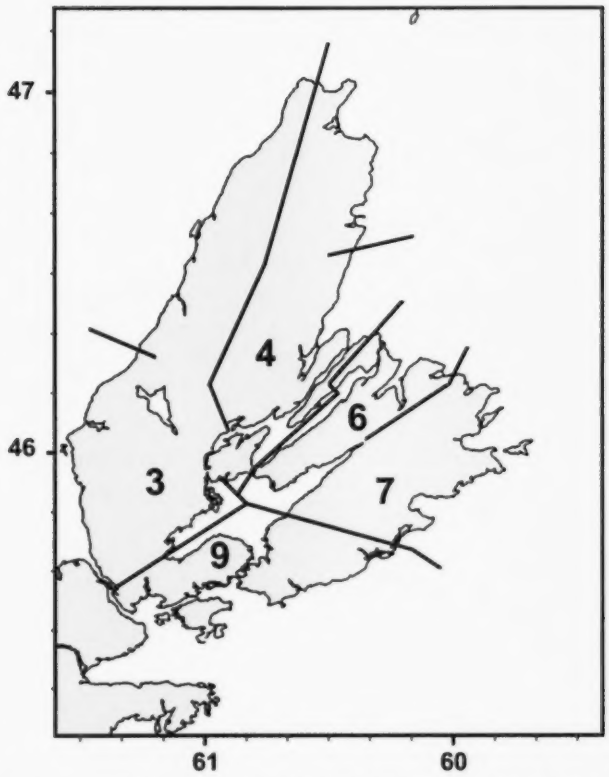

Figure 1. Statistical districts for the Bras d'Or Lakes.

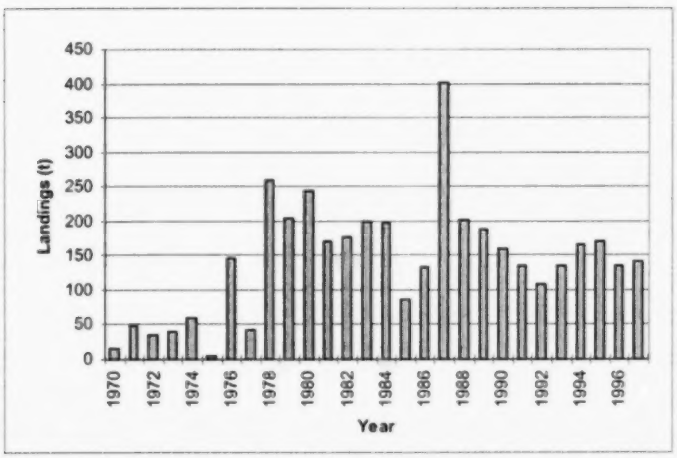

Figure 2. Recorded landings for the Bras d'Or spring fishery, 1970 to 1997.

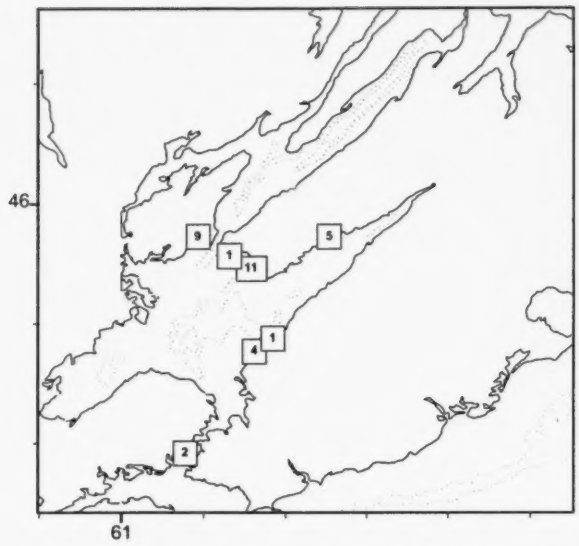

Figure 3. Distribution of biological samples collected during the 1996 spring fishery. The numbers in the boxes indicate the number of samples taken at that location.

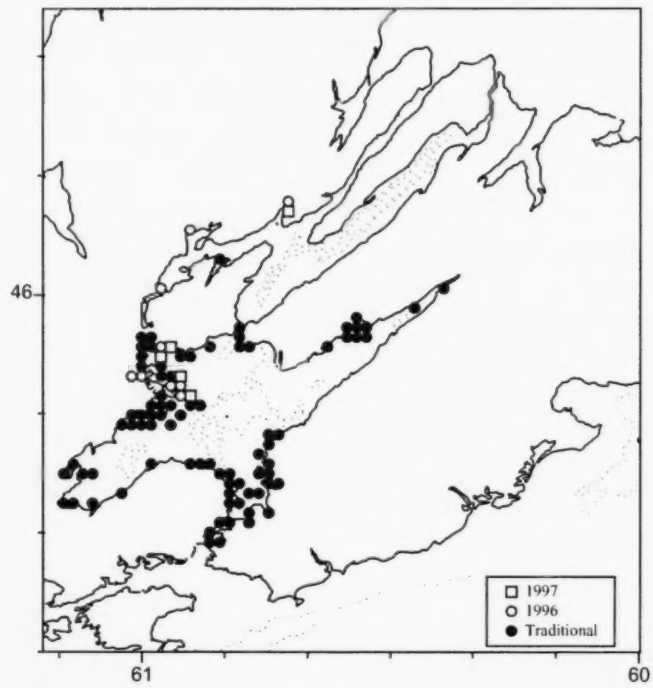

Figure 4. Active and traditional spawning areas in the Bras d'Or Lakes.

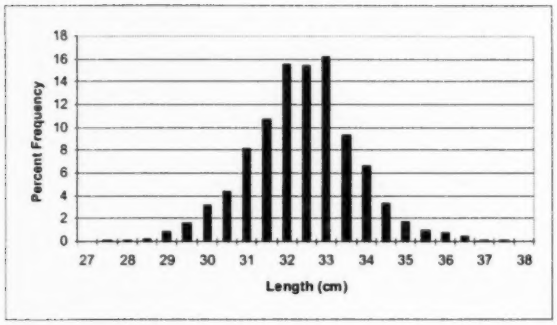

Figure 5. Length frequency for 33 herring samples collected (5496 fish measured) from the 1996 spring gillnet fishery in the Bras d'Or Lakes.

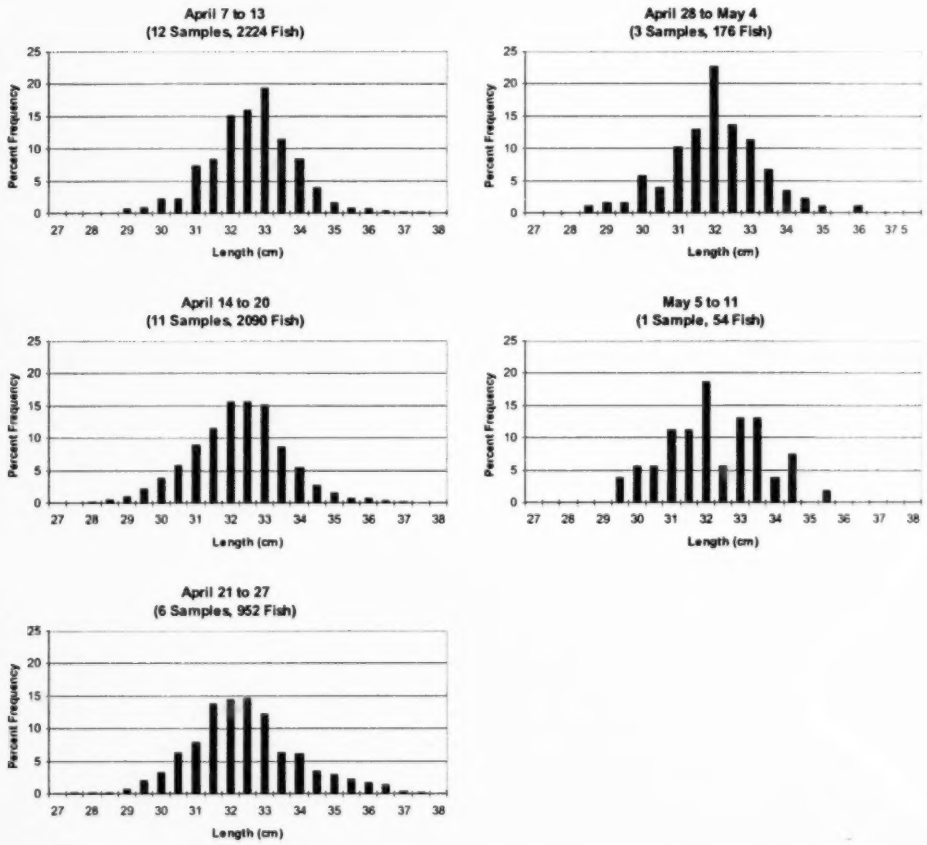

Figure 6. Length frequency samples by week for the 1996 Bras d'Or Lakes spring fishery.

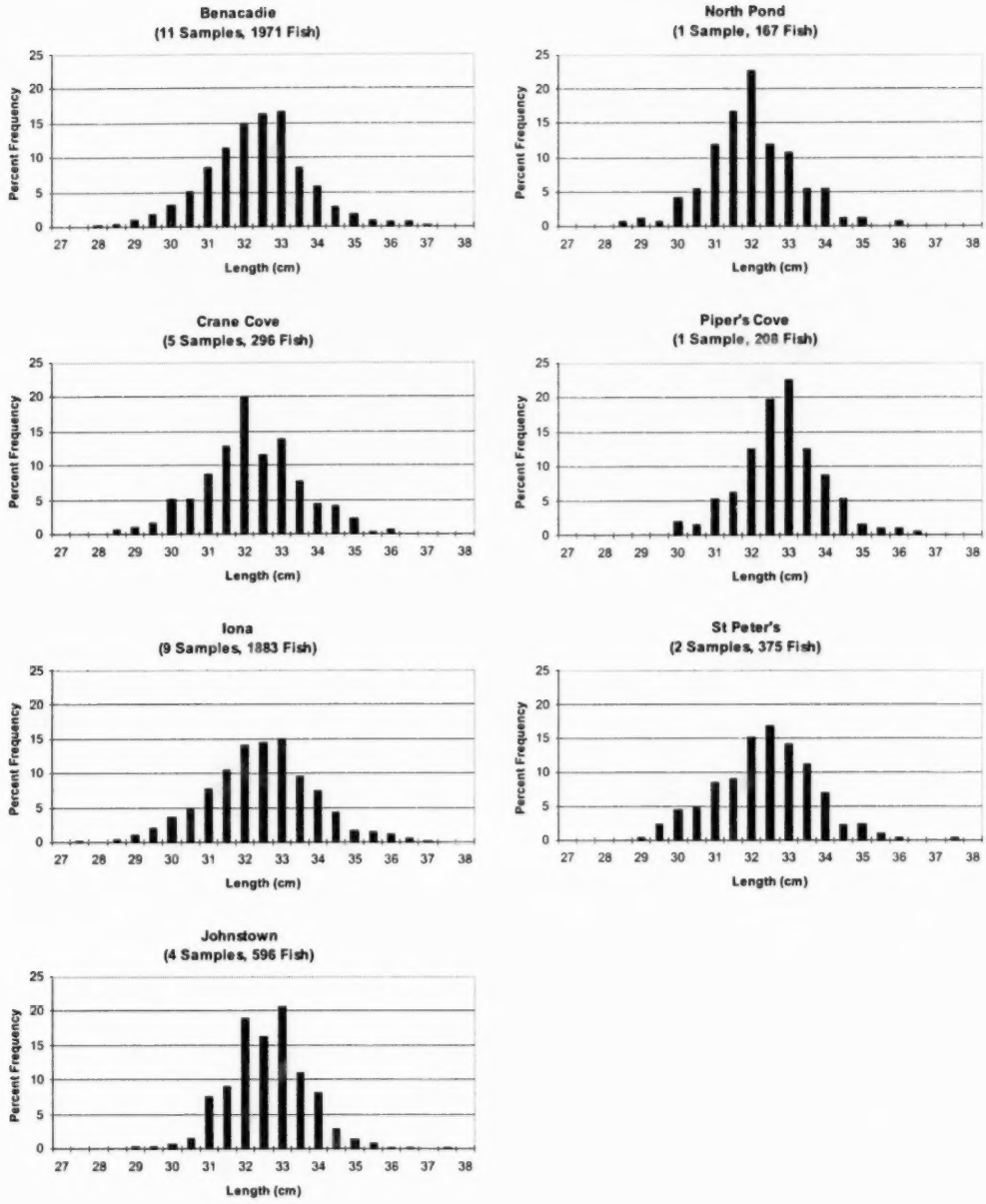

Figure 7. Length frequencies of samples by location for the 1996 Bras d'Or Lakes spring fishery.

Figure 8. Catch at age for the 1996 spring gillnet herring fishery on the Bras d'Or Lakes spawning component in percent numbers and percent weight.

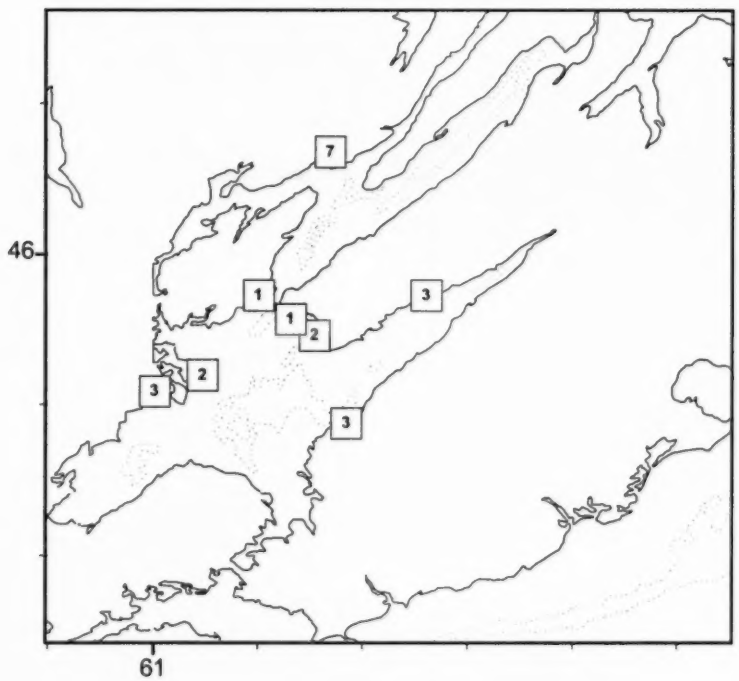

Figure 9. Distribution of biological samples collected during the 1997 spring fishery. The numbers in the boxes indicate the number of samples taken at that location.

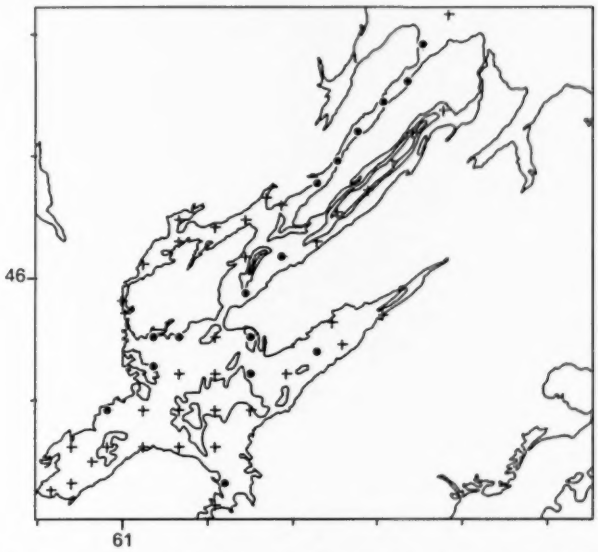

Figure 10. Bras d'Or Lake larval herring sampling locations, Navicula 97-078. Circles represent locations at which larvae were found. Crosses indicate locations at which no larvae were found.

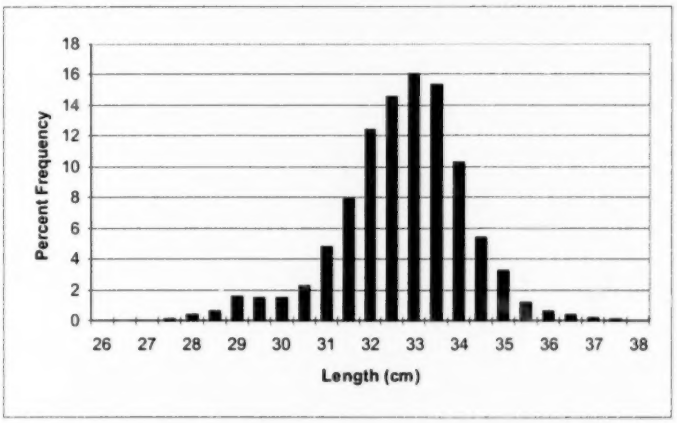

Figure 11. Length frequency for 22 herring samples collected (3749 fish measured) from the 1997 spring gillnet fishery in the Bras d'Or Lakes.

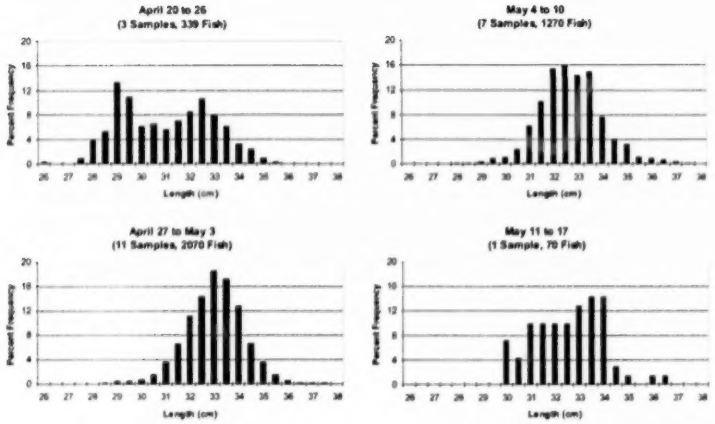

Figure 12. Length frequency samples by week for the 1997 Bras d'Or Lakes spring fishery.

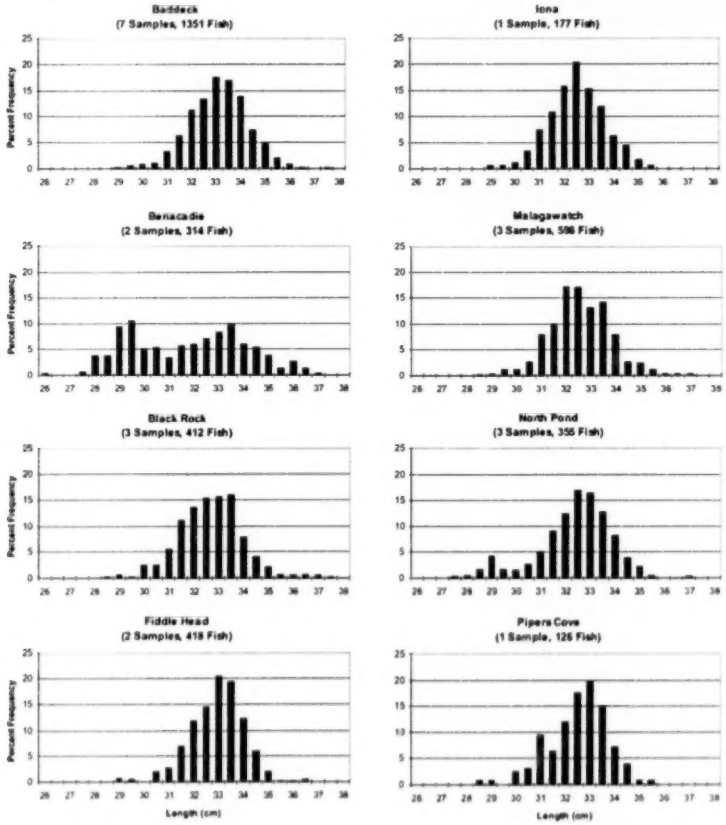

Figure 13. Length frequency samples by location for the 1997 Bras d'Or Lakes spring fishery.

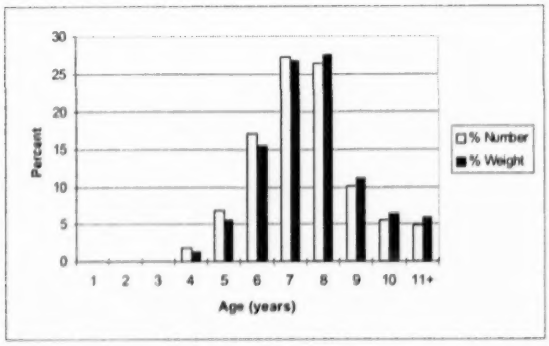

Figure 14. Catch at age for the 1997 spring gillnet herring fishery on the Bras d'Or Lakes spawning component in percent numbers and percent weight.

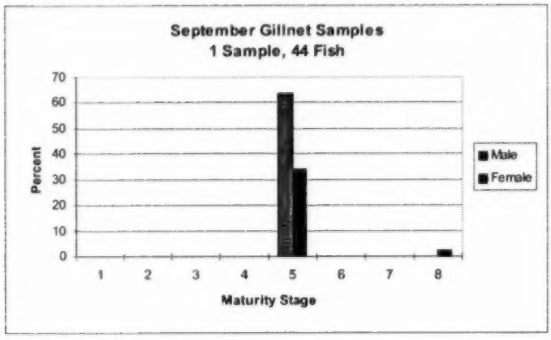

Figure 15. Maturity stages for herring sample collected from the 1997 fall gillnet bait fishery in the Bras d'Or Lakes.

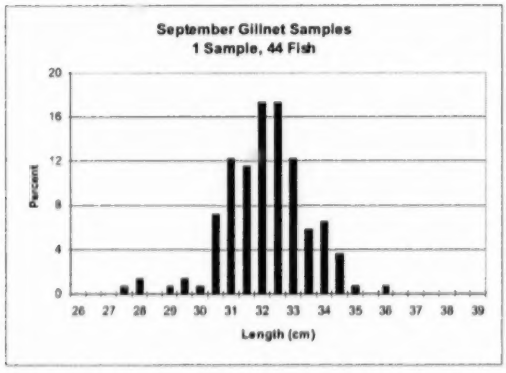

Figure 16. Length frequency of the herring sample collected from the 1997 fall gillnet bait fishery in the Bras d'Or Lakes.

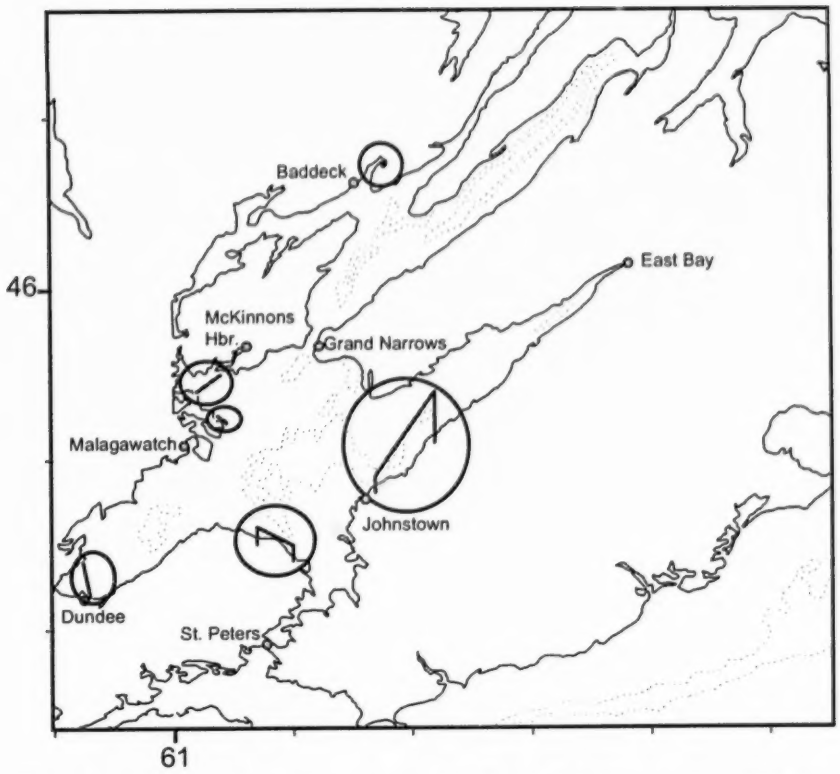

Figure 17. Closed areas proposed in the 1998 Management Plan.

Appendix 1

Notes on the spring herring fishery in the Bras d'Or Lakes (1991 to 97) taken by Jim Fennell (DFO port sampler based in Cape Breton).

	Week 1	Week 2	Week 3	Week 4	Week 5	Week 6	Other Comments
1991	April 19 to 27 Spawning North side Marshy Pond Pitcher Hbr]	April 28 to May 4 Spawning South side	May 5 to 11				
1992							
1993	April 15 to 25	April 26 to May 2					
1994	April 11 to 18 Spawning	April 19 to 25	April 26 to 29	April 30 to May 6	May 7 to 13 No spawning observed		
1995	April 3 to 9 Spawning April 5 on North Point Area Beach side Big Lake]	April 10 to 16 Spawning April 12 on South side	April 17 to 23	April 24 to 30 No spawning observed			
1996	March 23 to 31 Fished on Bras d'Or Lake	April 1 to 7 Fished on Bras d'Or Lake	April 8 to 14 No spawning Spawning off Marshy Pond	April 15 to 21 No significant spawning although some was present North Pond	April 22 to 28 No spawning	May 1 to 7 No spawning	
1997	April 15 to 25 Fished on Bras d'Or Lake No spawning except patchy on Marshy Pond where fairly good Another farm white	April 26 to May 2 Fished on Bras d'Or Lake No spawning	May 3 to 9 No spawning				

Appendix 2: Fisher Questionnaire

Bras D'Or Lakes Herring Study

Name(s): _____

Vessel: _____

Number of years fishing for herring: _____

A) In 1996:

1. Where did you fish? _____
2. What gear was used? _____

Number of nets: _____

Mesh Size: _____

3. How many nights did you fish? _____
4. How much herring did you catch? _____
5. Comment on the 1996 Fishery:

Abundance? _____

Location? _____

Fish Size? _____

Fish Condition? _____

Other? _____

B) In previous years:

1. Do you have records of your catch in previous years? _____ _____
   yes **no**
2. Please list your Bras D'Or herring catch in past years:

1994	**1993**	**1992**	**1991**	**1990**	**1989**	**1988** ⇒
_____	_____	_____	_____	_____	_____	_____

3. How has your gear changed over time?

	1995	**1994**	**1993**	**1992**	**1991**	**1989**⇒
No. of Nets						
Mesh Size						
Fishing Area						
Time and Duration of Fishery						

C) **Herring Biology:**

1. Please identify areas of known herring spawning on the attached map:
   a. for 1996
   b. for previous years

2. Please draw the pattern of herring movement through the lakes on the attached map.

D) **Comments:**

1. Has there been a definite change in the number of herring in the Bras d'Or Lakes over time?

   Yes **No**

   If so, when did you begin to notice this change?

2. Who else should be interviewed regarding the Bras D'Or Lakes herring fishery?

3. Other comments:

Name of Interviewer: _____
Date: _____

Appendix 3 - Questionnaire Results

Bras d'Or Lakes Active Herring Fishers Spring 1996
Summary of Interview Results

Personal interviews were undertaken with active herring fishers. Out of the 30 fishers known to fish the Bras d'Or Lakes in 1996, 29 interviews were completed. A summary of the findings for particular categories in the questionnaire are presented below.

Table 1. Results of Fisher Questionnaire.

						CHANGE IN GEAR OVER TIME		
DESCRIPTION	ABUNDANCE	LOCATION	SIZE	CONDITION	RECORDS	NETS	MESH SIZE	LOCATION
Same	2	8	16	1		22	23	24
Different		19					3	4
Increase	2					2		
Decrease	18					2		
Larger								
Smaller			11					
Good			1	3				
Soft				3				
Firm				11				
Ready				11				
Yes								
No					10			
Not sure	6	1	1		19			
No Answer	1	1				2	1	

A) **In 1996:**

Herring nets were distributed throughout the Bras d'Or Lakes, except in the East Bay (east of Eskasoni to Middle Cape) and West Bay (west of Cape George to Lime Hill). The nets were found to be concentrated around Marble Mountain and Big Harbour Island areas with 86 nets recorded. Also, 58 to 60 nets were set at Johnstown Harbour. The number of nets set ranged from 4 to 40. The fishery was both for personal bait and sale (also mostly for bait).

Set gillnets were the most common method of catching herring. All nets contained mesh that ranged in size from $2^{1}/_{8}$ to $2^{7}/_{8}$ inch. Mesh sizes 2½, $2^{3}/_{8}$ and $2^{5}/_{8}$ inch were most frequently used. Only one individual used a trap net in addition to nets.

Length of fishing by individual fishers lasted between 4 and 45 days. The mode was found to be 21 days fishing. Most fishing took place during the early morning although one crew also fished 14 nights.

The amount of herring caught per fisher ranged between nil and 62,900 lbs. Quantity appeared to be related to location. Few herring were found below (to the west of) Marble Mountain. Herring appeared to be concentrated in the upper, western parts of

the Lakes. The total 1996 catch in the Bras d'Or Lakes is estimated from this survey to have been between 376,000 and 392,000 lbs.

Comments:

In terms of **abundance**, the majority of those interviewed (18) felt that there were less herring. Only 2 felt that there were more herring than the previous year and 2 thought that the fishery remained the same. Six fishers did not know if abundance was the problem or if the fish had not returned to the same areas to spawn. One individual did not comment on abundance.

With regards to **location**, the herring are not being found in the same areas. The majority of fishers (19) felt that schools were scattered and no longer in the same locations. A few changed fishing locations in search of them. Previously, fishers would wait until the fish came to them but this is no longer the case. Eight felt that the locations of herring were the same and only one individual had no comment.

Sixteen fishers stated that the **sizes** of herring were average for the nets. Others (11) found the fish to be larger. Many commented that there were no longer smaller herring, as if a size class was missing. One reported that the size of the herring appeared to be getting smaller.

At the time of removal, the **condition** of the herring was firm (11) or ready to spawn (11). A soft condition (3) was also reported. Other comments included "good" (3) and "same" (1). The general consensus was that the condition of the herring was no different than in previous years.

B) Previous Years

The majority of fishers (19) reported that they did not have catch records for previous years. Catches reported are from memory in most cases except for 2 fishers. DFO has records for those who sold herring.

Gear did not change dramatically over time. The majority (22) maintained the same number of nets; two had increased the number set as time went on and 2 had decreased the number set over time. Some individuals set more nets to get the same amount while others decreased the amount of nets because there were few herring. Locations of fishing also remained constant. Twenty four fishers fished at the same locations whilst 4 had tried different areas since they started. Mesh size also remained the same. Twenty three individuals kept the same mesh size during their fishing career. Three fishers changed their mesh size and two of these 3 changed to larger mesh. One individual could not give any information on this matter since 1996 was his first year fishing.

The timing and duration of the fishery was felt to be largely determined by the presence of ice on the Lakes. Fishing generally began as soon as the ice was gone from coves. Fishers from different areas reported different times that the herring would arrive and it usually varied by a week or two from the time herring were noticed at Grand Narrows. 1996 was an unusual year because there was no significant amount of ice on the Lakes.

C) Spawning Areas and Migration:

Traditional spawning areas are shown in **Figure 3**. Spawning was reported from only a few of these areas in 1996 (**Figure 3**). These observations were confirmed by egg bed surveys. According to the fishers surveyed, the locations at which spawning occurred in 1996 were Birch Point, Fiddle Head, Fraser's Cove, between Morrison Cove and Gillis Cove, Orangedale and Herring Choker Cove. More spawning may have occurred north of the Grand Narrows bridge.

The movement of herring through the Lakes is not fully understood. It is believed that the herring come from "outside" through the channel, past the bridge into the Lake. About half of the fishers interviewed strongly believe that wind direction plays an important role in the movement of herring within the Lakes. They feel that a strong Northeast wind will drive them from Big Harbour Island to the southern portion of the Lake.

D) Comments:

There is a strong notion (26 out of 29) that there is a change in the number of herring in the Bras d'Or Lakes. Only 3 individuals felt that the change is in the location of herring rather than the number. Impressions of the timing of the decline vary considerably. Many feel that this happened gradually, with less and less herring coming in yearly. Others feel that since 1980, 1981 and 1983 the quantity has not been the same. Others suggest that the decline in herring numbers began in 1986, 1991, 1992 or 1994. One fisher thought the decline since 1994 was dramatic and another thought it was part of an on-going cycle.

1996 seemed to be an unusual year. It was reported that the herring have not come into the Orangedale (North Denys Basin) for at least 20 years. Another individual also reported that the lack of herring experienced in 1996 had occurred previously around 20 years ago. Enough herring for bait could not be obtained that year but there was "plenty" of herring the following year. Also, there appeared to be more fall herring in the St. Peter's area in October than there had been in April. These herring are larger, darker (called Blackback or Bank Herring by locals) and definitely not spring spawning Bras d'Or herring.

Fishers' explanations of the decline ranged from draggers to DFO. While many are concerned with seals, nets on shore, wasted herring and the roe fishery, the

explanations most often expressed for the decline were that seiners are depleting the stocks outside the Lakes, there is an increase in the amount of nets and there is an influx of new fishers concentrating in one area. It is believed that too many nets in the Barra Strait not only capture herring before spawning, but also interrupt their migration route, causing them to turn around and leave. There are reports that some fishers are setting more nets or fleets than their license permits.

Although sceptical at first, the majority of fishers have been eager and anxious to help improve the fishery. Some suggestions made by fishers include implementing a quota, allowing a bait fishery only or a temporary closure of the Lakes for conservation until the population is restored.